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THE HIGH SCHOOL COURSE IN CHEMISTRY[1]

THE study of chemistry is a valuable constituent of the high-school course on account (1) of the first-hand information which it gives about well-known materials, the principles of their manufacture, and their properties, as the result of personal observation; and (2) of the training in observation in general and correct induction from observation which it affords. Without laboratory work it is almost wholly valueless for these purposes. It should be preceded by physics, since chemistry necessarily assumes a knowledge of the physical properties of matter and of the phenomena connected with heat and electricity. If, on account of limited teaching force, relatively little time can be given to the sciences, it is preferable (as the "Committee of Ten" advise), to give a year each to one or two sciences than shorter periods to a larger number. It must be remembered that, for the efficient teaching of science, preparation of apparatus and experiments for demonstrations and laboratory work are necessary, and the science teacher cannot therefore carry more than half the number of recitations assigned to most other teachers.

1. *Time.*—The work outlined below will demand at least 200 hours' work; about half the time, in two-hour periods, should be spent in the laboratory.

2. *Methods of teaching.*—To make the study of any value,

[1] Prepared by the Department of Chemistry of the University of Chicago.

personal observation in the laboratory must be followed by thorough discussion of the results individually and in class.

Laboratory work.—The experiments must be performed by each pupil individually.

Each pupil must record his observations and the interpretation of them in a notebook. His work should be continuously supervised and his records frequently examined by the teacher.

Most pupils will tend to fall into merely mechanical performance of assigned work. To combat this is the most difficult task of the teacher of chemistry. Each experiment is a question put to nature, and forethought and care are necessary in putting the question, and study and reflection in interpreting the answer. Strenuous effort is required to make the pupil realize this.

Beginning at an early stage in the course, simple quantitative experiments should be given, in order to illustrate the laws of definite and multiple proportion, the determination of combining weights, the sp. gr. of gases, etc. This will enable the pupil to appreciate the fact that, although the quantities used in the majority of laboratory exercises may not be measured, yet the quantities of matter involved in all chemical changes are definite and measurable. Without such measurements the law of definite proportions cannot be really grasped and will soon be forgotten, and atomic weights will seem purely mythical. Not less than six such exercises should be given.

One or two of these experiments must be introduced early in order that formulæ and equations, when the time for their employment comes, may be given as abbreviated expressions of the results of quantitative measurements. The pupil must never seek information by constructing an equation. Observation is the only source of information and the equation simply expresses the quantitative relations observed. All "exercises in writing equations" and rules for constructing them, as if they were mathematical expressions, must be rigidly excluded.

Qualitative analysis is a branch of applied chemistry and cannot be learned otherwise than mechanically without a long preparation in general chemistry. There should be no pretense

of teaching it in a secondary school as part (much less as the whole) of the first year's work. It gives a distorted view of the classification of the elements and of the relative importance of their properties, and bears the same relation to the science of chemistry that the Linnean system of classification in botany bears to the natural.

Yet exercises on the recognition of chemical substances will tend to fix their properties in the mind and give a useful review of many of the facts and principles of the science, provided that a proper method of conducting them be pursued. Analytical tables encourage mechanical work in a remarkable degree and cannot be permitted. An outline suggesting suitable dry and wet-way experiments, which will throw the burden of thought and rigid proof on the pupil will be a sufficient guide. This part of the work may fitly occupy five or six weeks of the course.

Demonstrations.—Many parts of the subject can best be introduced by means of carefully reasoned and fully illustrated demonstrations by the teacher. Sometimes also this method of teaching has to be used where the apparatus is complicated and cannot be supplied to each pupil, or where, in striving to make the experiment successful, the pupil will be in danger of wasting time. Thus on pedagogical or practical grounds many of the Hofmann experiments for illustrating Gay Lussac's law of volumes (explosion of hydrogen and oxygen, electrolysis of hydrochloric acid, etc.) are best performed by the teacher.

Library.—Interest in the study should be fostered by providing a small library. The use of this will counteract the idea which the pupil may possibly receive that the text-book employed in the class is a "complete" treatise. It should contain some more advanced works as well as some of a more popular nature.

3. *Subject-matter.*—The following outline includes only the indispensable things which must be studied in the class room and laboratory. The material is for the most part common to all elementary text-books and laboratory manuals. Each book makes its own selection of facts beyond this which may be necessary for the illustration of the principles of the science. The gen-

eral scope of the work may be gathered from examination of Remsen's *Briefer Course*, Storer and Lindsay's *Chemistry*, and laboratory manuals of White (*Elementary Chemistry*), and Newth (*Elementary Practical Chemistry* for non-metals), and the new syllabus of laboratory exercises used in Chicago city schools. The following outline is to be viewed in relation to the ground covered by such works.

Outline.—The chief physical and chemical characteristics, the preparation and the recognition of the following elements and their chief compounds: *Oxygen*, *Hydrogen*, *Carbon*, *Nitrogen*, *Chlorine*, *Bromine*, *Iodine*, Fluorine, *Sulphur*, Phosphorus, Silicon; Potassium, *Sodium*, Calcium, Magnesium, *Zinc*, Copper, Mercury, Silver, Aluminium, *Lead*, Tin, *Iron*, Manganese, Chromium.

More detailed study should be confined to the italicized *elements* (as such) and to the following *compounds:* Water, Hydrochloric Acid, Carbon-monoxide; Carbon-dioxide, Nitric Acid, Ammonia, Sulphur-dioxide, Sulphuric Acid, Hydrogen Sulphide; Sodium-hydroxide.

Attention should be given to the atmosphere (constitution and relation to animal and vegetable life), flames, acids, bases, salts, oxidation and reduction, crystallization, manufacturing processes, familiar substances (illuminating gas, gunpowder, baking powder, mortar, glass, metallurgy, steel, common alloys, porcelain, soap).

Combining proportions by weight and volume; calculations founded on these and Boyle's and Charles' laws; symbols and nomenclature (with careful avoidance of special stress, since these are non-essential); atomic theory, atomic weights and valency in a very elementary way; nascent state; grouping of the elements; solution (solvents and solubility of gases, liquids and solids, saturation); ionization; conservation and dissipation of energy; chemical energy (very elementary).

Suggestions.—Chemical terms should be defined and explained, and the pupil should be able to illustrate and apply the ideas.

Formulæ should never be used in place of names. Chemical changes should be expressed by words as well as by equations.

Attention should be drawn to the fact that the latter are partial statements — are simply expressions of quantity — and hold under certain conditions only, which should be carefully described. Thus, $Zn + H_2SO_4 = ZnSO_4 + H_2$ is even untrue, unless the other conditions, particularly the presence of water, are specified.

4. *Examinations.*— These should be so constructed as to test knowledge of facts and principles, ability to reason, and cultivation of the scientific imagination. They should reveal laboratory experience or its absence.

5. *Equipment.*—Laboratory. Proper desks at least 2 feet 3 inches deep and allowing places 3 feet 6 inches long for each pupil, with gas and water connections and bottle racks, cupboards, and drawers are necessary for efficient chemical work. One hood with good ventilation, for every four to six students is indispensable.

Apparatus.— Each pupil should be supplied with a set of apparatus for which he is held responsible. Some pieces of apparatus, which are expensive or are less frequently employed, may be kept in the laboratory for common use. Of this nature are most of the articles required for quantitative experiments. Detailed lists of apparatus and chemicals will be found in Remsen's *Briefer Course* and other texts.

In view of the prevailing idea that quantitative experiments require expensive apparatus, it may be mentioned that a balance costing $12.50 and weights ($1.25) will amply suffice, and efficient work is being done in some schools with ordinary hand scales costing less than $1.50! There should be one balance to every six pupils working at one time. In addition to this the following will be required:

Barometer; thermometer, one for twelve pupils; burettes, two for four pupils; porcelain crucibles for each student; bottle for aspirator (one litre) for each student.

Most of the apparatus for demonstrations can be made by the teacher by use of the blowpipe, some glass tubing of various sizes, and a few pieces of thin platinum wire.

Richards & Co., Sargent & Co. in Chicago, and Eimer & Amend in New York will give estimates for supplies of all descriptions.

Library.—The following list is suggested, though the use of some of the books will probably be confined to the teacher. In case the complete list cannot be purchased, those which are specially recommended have been marked with an asterisk. The prices given are in most cases subject to discount.

Roscoe & Schorlemmer, Treatise on Chemistry, Vols. I and II (Appleton, $11.00).

*Remsen, Chemistry, Advanced Course (Holt, $2.80).

Mendelejeff, Principles of Chemistry (Longmans, $10.00).

*Newth, Inorganic Chemistry (Longmans, $1.75).

Ostwald-Walker, Outlines of General Chemistry (Macmillan, $3.50).

*Walker-Dobbin, Chemical Theory for Beginners (Macmillan, 70 cents).

*Ostwald, Scientific Foundations of Analytical Chemistry (Macmillan, $1.60).

Remsen, Organic Chemistry (Heath, $1.20).

Fresenius, Qualitative Analysis (Wiley, $4.00).

Remsen, Theoretical Chemistry (Lee, $1.60).

*Tilden, Hints on Teaching Elementary Chemistry (Longmans, 75 cents).

*Ramsay, Experimental Proofs of Chemical Theory (Macmillan, 60 cents).

*Newth, Chemical Lecture-experiments (Longmans, $3.00).

Cornish, Practical Proofs of Chemical Laws (Longmans, 75 cents).

Faraday, Chemistry of a Candle (Harper, 85 cents).

Appleton, Handbook of Chemistry (Silver Burdette & Co., $1.00).

Johnston, Chemistry of Common Life (Appleton, $2.00).

Tracy, Sanitation (Appleton, 50 cents).

Church, Food (Scribner, $1.20).

Richards, Cooking (Estes & Lauriat, 50 cents).

Richards, Food Materials (Estes & Lauriat, 50 cents).

Ramsay, Gases of the Atmosphere (Macmillan, $2.00).

Lassar-Cohn, Chemistry of Every Day Life (Lippincott, $1.75).

E. v. Meyer, History of Chemistry (Macmillan, $4.50).

Liebig, Chemical Letters.

Muir, Heroes of Science, Chemistry (Young, $1.25).

*Thorpe, Essays in Historical Chemistry (Macmillan, $2.25).

Shenstone, Liebig, Century Series (Macmillan, $1.25).

Roscoe, Dalton, Century Series (Macmillan, $1.25).

*Alembic Club Reprints (Historical). Chem. Pub. Co., Easton, 50 cents each.

1. Experiments upon Magnesia Alba, Black.
2. Foundations of the Atomic Theory, Dalton, Wollaston, Thomson.
3. Experiments on Air, Cavendish.
4. Foundations of the Molecular Theory, Dalton, Gay Lussac, Avogadro.
5. Extracts from Micrographia, Hooke.
6. The Decomposition of the Alkalies and Alkaline Earths, Davy.
7. The Discovery of Oxygen, Priestly.
8. The Discovery of Oxygen, Scheele.
9. The Elementary Nature of Chlorine, Davy.
10. Researches on the Arseniates, Phosphates and Modifications of Phosphoric Acid, Graham.
11. Essays of Jean Rey.
12. The Liquefaction of Gases, Faraday, Northmore.
13. Early papers on Chlorine, Scheele, Berthollet, Gay Lussac and Thenard.
14. Researches on Molecular Asymmetry of Natural Organic Products, Pasteur.

THE PREPARATION OF THE HIGH SCHOOL TEACHER OF MATHEMATICS

THERE is an important sense in which the preparation of every teacher is beyond the reach of human influences. His preparation has begun before his birth. He is either endowed by nature with personal qualities that should forever exclude him from the ranks of the teaching profession, or he possesses such qualities, as under appropriate training, enable him to overcome the inevitable difficulties that will beset his path, and ultimately to attain varying degrees of usefulness from mediocrity to the highest skill in his art. If he is a physical or mental weakling, if he is stolid and heavy, if he is indifferent to nature, human nature, and art, if he lacks enthusiasm in the pursuit of his subject and never feels the glow of conscious mastery, if he has a crabbed or irritable disposition, if he is brilliant but unsympathetic, if he lacks an interest in his pupil at least equal to his interest in his subject, if he has no tact, and is lacking in the sense of humor that often furnishes the silver lining to an otherwise black cloud of youthful idleness or seeming perversity —in a word, if he is not physically and mentally vigorous, alert and active, if he is not interestedly and healthily responsive to the varied interests of life, if he cannot cherish a feeling of good will and maintain a hopeful and encouraging attitude in spite of many discouragements and some failures, whatever he may be able to achieve in other callings, he ought never to be a teacher. I need hardly say that, in what follows, adequate natural capacity and a responsive nature are assumed, and that my discussion pertains only to the preparation of the would-be teacher who possesses these characteristics.

The preparation needed by every high-school teacher is both general and special; that is to say, it should cover the essential elements of a liberal education, and special training in that sub-

ject or group of closely related subjects which the teacher expects to teach; together with enough professional training to show him his responsibilities to his pupils as well as to his specialty, and help him to become as good a teacher as possible as soon as possible. That a high-school teacher should, in general, have profited by an education at least equivalent to that afforded by a good American college, ought to be universally recognized. Since this is not the case, one must assume either indifference to or ignorance of the importance of a liberal culture for high-school teachers on the part of those who employ the teachers, or are responsible for their employment. Under such circumstances, it becomes one's duty to do what he can toward influencing public opinion on this very important matter. I am aware that in this presence this endeavor is unnecessary, if not somewhat presumptuous; but I am sure that the deliberations of this club are intended not merely for the enlightenment of its members but also to promote the dissemination of wholesome educational ideals in the larger community outside, which the members of this club serve as educational advisers and teachers, and the intelligent coöperation of which they aim to secure in every legitimate way. It seems worth while, therefore, to point out briefly the serious consequences of indifference or ignorance on the part of employers of high-school teachers as regards the general culture essential to real efficiency.

It must be borne in mind that high-school pupils are no longer little children, uninformed and unsophisticated. Besides possessing a considerable store of general information, they have usually learned to read human nature tolerably well where their own interests are concerned. Superficial knowledge, and limited mental power, narrow views of life, rusticity of manner —all of them marks of meager culture—rarely escape detection in a high school; and particularly for the brighter and socially superior pupils offer a serious obstacle to the teacher's usefulness, if they do not destroy it altogether. It is a serious disadvantage to every high-school pupil, whether he is aware of it or not, perhaps even more serious if he does not know it than if

he does, to have his mental horizon determined by the narrow mental horizon of his teacher; his intellectual vistas and sympathies limited or dwarfed by the inadequate intellectual insight and want of perspective on the part of his teacher; to have his notions of social refinement and cultivation unformed, or deformed, or even perverted by the uncultivated man or woman who happens to be his teacher. The high school supplies to most pupils their last chance at these stores of inspiration and guidance, and they should be the very best. Such disadvantages to the pupil do not appear, and such obstacles to the teacher's success can hardly exist when the general culture and refinement of the high-school teachers are sufficient always to command the just respect and challenge the regard, if not to inspire the imitation, of the best pupils. For such an equipment those who have tried it will agree, I am sure, that, in general, four years of training in a good college are little enough.

This view is strengthened by the reflection that there is no period in a young person's life in which impressions received produce a more lasting effect, in which incipient interests, and habits of thought and conduct are more permanently influenced than during the period covered wholly or in part by secondary education—the period of adolescence. It is often said that the earliest impressions are the most lasting and the earliest training is the most important for intellectual and moral development, and for the future usefulness and happiness of the individual; but I cannot believe that in most instances this is a true statement of the case, so far, at least, as those pupils are concerned whose school career is continued into and through the high school. If good early training were always followed by equally good subsequent training, if the child's opportunities for growth in knowledge and power were continuous, if his moral training and his social environment improved with his growth from early childhood through later childhood and youth, if his earlier acquisitions were really made to serve continuously and progressively as the foundation for continuous subsequent growth, then the earlier and earliest training would be of the utmost

importance; for it would be the foundation on which later development would be most economically and securely laid. But such conditions of development are rare. The cases are not common in which each stage of a child's progress is so nicely adjusted to the previous one. Such an arrangement of our courses of study and our teaching processes is as yet too commonly rather a vaguely conceived ideal. Moreover, the instability of the population, the perpetual migration of people in this country from one place to another, enormously increases the difficulty of approximating to such an ideal, even when it is consciously and conscientiously aimed at. But suppose that such an ideal were generally realized. It would still remain true that childhood in its first dozen years or so, with its ready adaptability to changing conditions, its rapidly changing dominant interests, in a word, its instability, would be affected most strongly by its latest influences. In my opinion it is quite possible for the later school life to make good the defects of early training; or, it may undo very largely what has been well begun, on the one hand, as, on the other, it may build on an excellent earlier foundation a superior superstructure. If this be true, and I believe it is (in the absence of scientific knowledge one can only generalize from his own experience and observation), the great importance of good teaching, wise management, and the most wholesome and refining general atmosphere in the high school are apparent. In any event, it will be admitted, I think, that as the period of adolescence approaches, and especially during that period, the instability above referred to rapidly diminishes. The individual gradually emerges. The child becomes a youth. This is a critical period in the life of every human being. To assume the wise guidance of young people during this important period is the exalted function of the secondary school-teacher. He is to be the inspiring, sympathetic discriminating, and vigorous guide and leader of boys and girls just developing into manhood and womanhood. To be such a guide and leader in very truth he must have resources, both natural and acquired. The least that should be demanded of him is that he shall have taken pains to secure an equipment of knowledge that

will give him broad, sane, and healthy views of life, with its duties and its privileges, and liberal intellectual sympathies; together with a conscious power in some one field that enables him to maintain, both for himself and his pupils, a high standard of achievement. Such an equipment every college graduate who has made good use of his opportunities may possess. It is not often that one who has not profited by such an education can be expected to possess it.

There are special reasons why the teacher of mathematics should have a liberal equipment of general culture in addition to special knowledge and power in his particular subject. Pure mathematics is profound and interesting; but its subject-matter, save in its elements, is so remote from the common interests of men that its devotees are in constant danger of what may be called a professional or academic isolation; and this isolation is almost sure to increase with increasing devotion to the subject. It has fewer points of contact with the ordinary affairs of life than natural science, or language, or history; to say nothing of subjects like economics and political science. In this respect mathematics differs from all other subjects. Factoring, radicals, and quadratic equations, polygons, parallelopipeds, and spherical triangles, sines, tangents and trigonometric formulæ, the theory of equations, determinants, and complex numbers, point and line coördinates, involutes and evolutes, derivatives, differential equations, and elliptic functions, may completely shut out from view the living panorama of nature and society in which most men live and move, and have their being, and from which the young, in particular, derive most of their incentives and conscious purposes. In my opinion it is therefore not asking too much that the high-school teacher of mathematics should possess and understand the importance of the general training that enables him to appreciate extra-vocational, *i. e.*, for him extra-mathematical interests. It ought never to be possible for the teacher of mathematics, however high he may rate the importance of his own subject and its beneficial effect on the pupil, to become one who measures the capacity of all pupils solely by

their ability to "do sums and to work problems," and the goodness of any course of study chiefly by the work in mathematics it prescribes.

But after all has been said that can be said of the necessity of broad general culture for the teacher of mathematics it is still emphatically true that his efficiency depends ultimately on his special training, on his resources in and power over his own subject; for it is through that subject that his special duty to the pupil is to be done. Either the pupil is to receive through him a peculiar insight into the marvelous system of the external world, some comprehension of the wonderful power and fertility of the human mind in one of its fields of activity, a quickening of his intellectual life through the knowledge and insight, the clearness and adequacy of exposition of mathematical truths characteristic of a scholarly, enthusiastic, well-trained teacher; or he must forever remain indifferent to these interesting, and some minds fascinating experiences, because both he and his teacher move about vaguely in a "world unrealized," where the intellectual fog never rises, and where the road traversed today must be re-traversed with the same dim uncertainty tomorrow.

If the teacher of mathematics has little mathematical ability, and if at the same time he has not had sufficient training, he is almost sure to carry on his work with a benumbing inadequacy of comprehension and exposition which soon becomes chronic, and through which the pupils come to look on mathematics as a highly artificial subject of little real interest or practical utility; a subject in which success does not depend on common sense and patient study, but on a certain inborn ingenuity of manipulating postulates, hypotheses, and previous propositions, and in which absurdities are as valid as realities.

A certain college student of my acquaintance must have had this kind of instruction. She said she had studied algebra before coming to college, but she had become interested in the subject only when she took up equations and proved "things." Whereupon I asked her if she had ever seen the paradox by which, through a series of equations, any number may apparently be

proved equal to nothing. As she had never seen it, I showed it to her, securing her assent to the several steps as I went on. When we arrived at the conclusion, $2=0$, I handed her the paper and looked up with the half apologetic, half triumphant manner of one who expects after a very brief triumph and a rather lame defense to yield the point in question. But nothing of the sort happened. She merely said "That's all right" and handed the paper back to me. "But," I said, "how can it be? Two cannot be really equal to nothing." "O," she said, "that's algebra."

The situation is not much improved, although it is quite different, if the teacher has good ability, but insufficient training. In that case he is oppressed by the consciousness of the heavy demands made on him and of his inability for a long time to respond to them as he should. The work must be done somehow, the classes cannot wait. He is thus obliged to carry on a discouraging struggle against tremendous odds. Meanwhile, his pupils are the losers, and the reputation of the subject suffers. Similar statements could, of course, be made with respect to inadequate preparation in other subjects as well as mathematics, but the immediate consequences are not so conspicuous. The definiteness and rigor of mathematical reasoning afford a constant and ruthless exposition of the teacher's shortcomings—an exposition which in other subjects is neither so glaring nor usually so disastrous. The teacher of mathematics must be a logical reasoner and ready in manipulation. If his training has left him without these powers, his other mental powers will avail him nothing. Either the pupil is right or he is wrong. Neither teacher nor pupil can escape the consequences of false reasoning or lack of skill in handling mathematical expressions. So, too, the glimpse the teacher gets of fields unexplored, which he vaguely realizes must have an influence on the interpretation of the work on which he is engaged, is a constant intimation of inadequacy, and so a source of self-accusation that heightens the acute "misery of conscious weakness" which he is sure to feel, and which is one of the most paralyzing of all the untoward influences that oppress the conscientious but meagerly equipped

teacher. There is no heavier burden than the burden of accepted duties that one feels he cannot adequately perform.

There is, of course, always hope for the able teacher inadequately prepared, for he may, by dint of hard work, ultimately achieve at least a moderate efficiency, although at the expense of many pupils; but there is no hope for the ignorant teacher of poor ability unconscious of his own ignorance. In either case the want of adequate preparation before actual service begins casts its shadow over his entire professional career.

To teach mathematics well in the high school, it is, therefore, hardly necessary to argue that one must have a thorough knowledge of the subject, a knowledge that is far in advance of pre-collegiate study, *i. e.*, far in advance of a good acquaintance with the branches of mathematics usually found in the high-school curriculum or such a presentation of them as is contained in the usual text-books. It is hardly necessary to argue that with an equipment limited to pre-collegiate study, the teacher of elementary mathematics is unable to comprehend the relative importance of the different phases of his subject. He may, and usually does, neglect important aspects and magnifies trifles. He treats facts and processes as ultimate ends in themselves, instead of means to ends. He never gets the comprehensive point of view from which the subject is unified and gains full significance in his own and the pupils' minds. His pupils not infrequently learn many things which subsequently must be unlearned—an expensive and exasperating experience. That he may escape this unfortunate situation, that he may from the start enter on his work well equipped for the demands that are to be made on him, I purpose now to enquire what should a good course of study, to be pursued by the high-school teacher of mathematics as special preparation for his work, comprise?

Bearing in mind that this course of study should enable the teacher to appreciate the relative importance of the different phases of his subject and of their interdependence throughout, and so enable him to select with certainty and wisdom those portions of mathematics essential to the elements of a liberal

education, or for future specialization in mathematics, if the pupil's interest and probable career should lead him into that field; and also that the teacher should know and be able to point out the significance of mathematics for the adequate development of power over other sciences, it is clear that the teacher's preparation must cover both pure and applied mathematics, and a general training in elementary physical science. Only through such knowledge is it possible to expect confidently that the teacher shall have an adequate, a wise, and firm grasp of essentials; and be able to impart to the pupil the scientific interest born of insight, unified knowledge, and perspective; and also a conviction of the fundamental utility of his subject in the pursuit of other sciences and in the practical affairs of life.

In view of these considerations, I suggest the following college course of study for the equipment of the high-school teacher of mathematics:

Advanced algebra, about fifty lessons, theory of equations, about fifty lessons (together with determinants and complex numbers); solid geometry, about fifty lessons; trigonometry, plane and spherical, about fifty lessons; surveying, about fifty lessons; calculus, about one hundred lessons; mechanics, about one hundred lessons; history of mathematics, about fifty lessons; physics, about one hundred lessons (general, with quantitative laboratory work); astronomy, about fifty lessons; chemistry, including mineralogy, about one hundred lessons; application of the calculus to light and heat, or to electricity, about one hundred lessons; history and theory of education, about one hundred lessons; methods, about fifty lessons.

Such a course of study should give the teacher of mathematics the original awakening and impetus, and furnish the permanent sources of inspiration and guidance without which growth and high efficiency are impossible. It places the teacher at the center of his subject, whence he can see and use its resources to the best advantage. The command it gives him over the resources, the problems, the historical development, and the practical and theoretical utility of elementary mathematics may

be expected to enrich and vitalize his teaching. Under a teacher thus equipped, the pupils feel that they are dealing with a fertile and a beautiful subject, and that they have a steady, able, and sure guide to the mastery of it. The halting and labored procedure, so characteristic of one who is not master of the situation, will be wanting; the pupils will perceive a definiteness and directness of aim and procedure, a facility of handling mathematical expressions which shows them how real it all is, how important, interesting, and useful it all is, and how accessible it all is to patient study; and, to the mathematical spirits among them, how fascinating and how simple it all may become. Such a course of study will make it impossible for the teacher of elementary mathematics to regard high-school algebra, geometry, and trigonometry as "higher mathematics," as I have heard some teachers call these subjects; but he will nevertheless have a just and high regard for these subjects, and will address himself to teaching them accordingly.

The teacher who has taken such a course of study will not be likely to teach nonsense about negative numbers or about imaginaries in elementary algebra. What he does teach about them the pupils will not have to unlearn at some future time. He will not believe that he has done his duty when he has led the pupil to solve simple equations with numerical coefficients, and allowed them to regard the literal equation as exceptional, and therefore entitled to only passing notice; he will not feel that the last word has been said on the significance of systems of equations when the pupils have learned the three common processes of elimination and have applied their knowledge to solving the usual highly artificial problems of the elementary algebras; he will not be able to regard the solution and discussion of the quadratic equation as virtually the end of achievement in algebraic analysis, and so on. So in geometry, he cannot be satisfied with exactness of language only; he must have good logic as well; he will attach due importance to the mastery of the propositions proved and the problems solved in the textbook; but he will never feel that the mastery of these proposi-

tions, with only an occasional "extra," gives pupils the comprehension and power they ought to gain from the subject, and so on. He will have learned that the branches of elementary mathematics have important interrelations, and will provide for a proper recognition of these interrelations in his teaching, thereby enhancing the interest and the comprehension of each. These are commonplaces, I know; my excuse for laying stress on them is that their significance is too often disregarded in practice.

That analytical geometry should form a part of this course of study is obvious. The knowledge of the conic sections which it affords and the great extension it gives to earlier conceptions of geometry, are so important, the relations between algebra and geometry which it reveals are so interesting and valuable, and the facility in handling mathematical expressions which it cultivates is so useful, that every lover of mathematics would insist on a training in analytics, and every teacher should possess this training for its influence on his teaching.

Similarly, little argument is needed to justify the appearance of the calculus and its applications in this course of study. The calculus is of such value to the mathematician as an instrument of research and as a basis of other sciences, that for him it is simply indispensable. For the teacher of elementary mathematics it throws such a flood of light on principles and extends their significance, both in pure and applied mathematics, and develops the mathematical skill already acquired to such an extent that it is of inestimable value in helping the teacher to develop comprehension, interest, and skill on the part of his pupils. To illustrate the influence of the calculus on the equipment of the teacher I need only refer to its effect on his power over the theory of limits, to the insight afforded by the applications of the calculus to analytics, to the facility of manipulation cultivated from the very beginning in the processes of differentiation and integration, and in the applications of the calculus to analytics already referred to, and to the appreciation the calculus affords of the utility of mathematics through its applications to mechanics, and to the study of light, heat, or electricity.

This course of study provides also for an acquaintance with the history of mathematics. It is strange that this interesting subject should have been neglected so long in this country. To this day I know of no college or university among us that offers a course in the history of mathematics. This is all the more strange when we think of the addition to the teacher's resources comprised in a knowledge of this subject. Quite apart from the clearer insight which such a knowledge gives into principles and processes — which is, of course, important — it should be borne in mind that the history of a subject is a part of the history of culture, and so an important part of the history of civilization. The inspiring victories of peace, the intellectual and moral conquests of the race, has for most minds at least as high an interest as the victories of war. The history of brilliant discoveries, or of the patient endeavor by which men have slowly worked out a science or a system of thought may therefore be employed to introduce into the teaching of every science a human element of great value; and especially into a science which, like mathematics, is necessarily formal and abstract. When the discoverer of a proposition is named and some of the circumstances of his career are added, a wholly new interest is added to the geometrical truth which before was known only as abstracted from all human concerns — it existed only in the book; now it is recognized as belonging to life.

So, too, the physical sciences — astronomy, physics, chemistry, and mineralogy — add so much to the significance of pure mathematics, and contribute such teaching resources that no mathematician and no teacher would wish to dispense with a knowledge of them. I have therefore included these sciences in the course of study needed by the teacher of mathematics. Finally, every science has an important practical utility which justly adds to the value attached to it by its devotion and by the world in general. An appeal to this practical utility is of constant use in teaching, because it is sure to be appreciated by the pupils, to say nothing (when occasion requires it) by their parents. I have therefore added astronomy, surveying, and intro-

duction to navigation to the course of study; these subjects comprise those important practical applications of elementary mathematics which the mathematician needs to know, and which everyone can appreciate.

Thus far I have been dwelling on the scholarship required for the teacher's outfit in mathematics. This is, of course, because scholarship is fundamental. But it is obvious that scholarship and the power to use scholarship effectively in teaching are two very different things. Hence, the teacher should have a general professional training, including, but by no means limited to, instruction in method. The professional training should cover enough of the theory and history of education to determine from the very beginning a professional interest and attitude on the part of the teacher in addition to his interest in his subject. It should enable him once for all to attain the conception that education is a rationalized endeavor, whose aim is the appropriate development of a human being, and his adaptation to the civilization into which he is born; and whose means are general culture, and in his hands the science of mathematics in particular. It should include also some instruction in methods of teaching mathematics. Prior to practice, it is not profitable, in my opinion, to spend much time on the details of teaching any subject. The most valuable instruction in the details of method of teaching any subject is that which proceeds *pari passu* with practice. Such instruction is, in most cases, impossible. What, then, should the instruction in methods comprise?

The student's course in educational theory should have given him a conception of the educational value of mathematics, *i. e.*, what mathematics may do for the pupil, and what by no possibility can be got from it. Instruction in methods should make sure that such a conception of the educational value of mathematics defines the teacher's ultimate aim, the aim that underlies and permeates all his work. Such an aim is essential to an adequate treatment of the whole subject, and it relegates all the phases of the subject to their proper places, and assigns to each phase its proper emphasis; and it makes clear the importance of

bringing home to the pupil the interdependence of the several branches. Instruction in method should also make clear the importance of a definite aim or definite aims in each recitation, *i. e., of a certain point or certain points to be made in today's work*, and of the importance of permitting and requiring the pupils to make these points themselves, so far as possible; and finally it should suggest a few modes of procedure—devices of class management and presentation, sufficient to serve the young teacher as a basis for success in his first lessons, and for working out his own devices as fast as he needs them. For such instruction about fifty exercises divided as occasion may render desirable between algebra, geometry, and trigonometry, are enough. To this instruction should be added as much study as possible of the methods of one or more good teachers in their class rooms.

Of course, the teacher's preparation for his work cannot be completed once for all prior to service. That the teacher must continue to be a learner if he would win and maintain a high efficiency, is eminently true of the teacher of mathematics. The nature of the subject is such that it easily lends itself to routine treatment. But such treatment means death to efficiency. The teacher's intellectual sympathies must be kept alive by continual efforts to overcome difficulties similar to those experienced by his pupils. The teacher who ceases to work out proofs or solutions, and is content with his past acquisitions and his collections of solved problems has stopped growing, and ought to be retired.

It is hardly necessary to add that every teacher should be a reader of our three or four leading educational journals, and that the teacher of mathematics cannot afford to dispense with the reading of two or three of the current mathematical journals. Of course few teachers would find the whole of each issue of these journals either interesting or profitable. But there is enough in each issue to repay careful attention. They extend the teacher's professional horizon and keep him abreast of the times in educational movements; and the mathematical journals promote his

growth in his own subject by acquainting him from issue to issue with the progress his subject is making through the achievements of his fellow workers. Moreover, both the non-mathematical and the mathematical journals constitute a source of valuable information concerning the respective merits of teaching resources, new and old—the text-books or other books on this subject; and he will find frequent discussions of aims and methods of presentation that serve as a constant means of clarifying his own views and improving his own methods—all this, of course, whether he agrees with the opinions expressed in a paper on the teaching of mathematics, or in some book review, or not. These sources of information and inspiration are used far too little. The present generation of high-school teachers, with the exceptions of the principals, is not given to much reading of educational literature, even the best.

In this paper I have endeavored to describe briefly what seems to me a good preparation for the high-school teacher of mathematics. That this preparation does not imply an excessive demand is illustrated by the fact that at least one normal school, the state normal school of this state (Michigan), provides a special preparation for would-be high-school teachers of mathematics, that very nearly covers the course in mathematics which I have described. Indeed, my own views of what should be demanded of high-school teachers of mathematics in the way of preparation were strengthened and confirmed when I learned what the students at this normal school who wished to become high-school teachers of mathematics were obliged to take; and that about twenty-five students were actually pursuing the greater part of this work each year.

That I have described a preparation that most high-school teachers at present in service have not enjoyed, I know. That it is exceedingly important that such equipment should be increasingly insisted on before the teacher is permitted to begin his work I firmly believe.

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FIELD WORK IN GEOLOGY AND PHYSICAL GEOGRAPHY

In the March and April numbers (1896) of the SCHOOL REVIEW I published an article on "The Teacher's Outfit in Physical Geography," in which field work was urged as a most important part of the rational methods of teaching the subject. As a result of this suggestion some correspondence followed with teachers who were interested in the idea. From this I learned that many who would like thus to improve the work did not know just how it could be done; and that many seem to think that some remarkable features must be at hand in order to carry out the plan.

In consideration of a certain apparent desire on the part of many teachers for more specific suggestions I have prepared the following paper in which I have purposely chosen very simple cases,[1] most of which will be possible for all teachers. These are, of course, merely taken as types to illustrate a method, and many better illustrations could be found by most teachers. Once knowing what is possible, the only difficulty will consist in the brief time open to this class of work.

Excursion 1 shall be a collecting trip, where the object is to obtain as many minerals, rocks, and fossils as possible. It may be to a quarry, or a mine, or through a ravine, or a railroad cutting. I will assume that it is to a stream bed within the region occupied by glacial drift. In the bed of the stream are numerous pebbles and bowlders washed from the rock walls and the drift banks. The teacher makes a collection and so does each of the students. No one is to obtain more than one of a kind and all are to try to obtain as many as possible. No name is

[1] It may be said that each one of these imaginary excursions is based upon a possible excursion within two miles of the Ithaca (N. Y.) High School, and most of them within a mile of the school.

given by the teacher to any of the specimens, but each student takes his collection back to the school. There each one is described carefully and fully, and then by comparison with a labeled collection they are named. All of the work is done by the student, and by it he is trained in seeing, thinking, and concluding for himself. This can be followed by any amount of identifying of unlabeled specimens, grouping of like kinds, noting resemblances and differences, etc. If a single locality cannot be found where several varieties are close together the method used in making collections of plants can be employed. In a glacial country many and often all common rocks and many minerals and fossils can be found in a single part of a stream bed.

The second excursion is to the same creek, where the stream is cutting at the base of a clay bluff a typical exposure of glacial drift. The pupils are told to explain the deposit and they are appalled by the magnitude of the task. Some have heard that it is glacial material, and they venture the suggestion. What is the proof? None is advanced. It can be made plain that the first step toward proof is the gathering of fact. So they begin the study of the conditions, and soon are called together for a statement of the results of their observation. It is a clay bank; not entirely, but with pebbles and bowlders from the size of a pin head to a hundred pounds' weight; the pebbles are angular, perhaps smoothed and scratched on one or two sides; they are not all alike, but of various kinds; and some of the kinds have never been seen by any of the class in any of the neighboring ledges.

The teacher volunteers the information that the home of many of the pebbles is miles to the north. Now in what possible ways could a mass of material be transported for miles and left in a bank? The answer is, wind, water, and ice. A vital objection to wind is the size of the pebbles. Water rounds and assorts materials, depositing them in layers according to the velocity of the current. A current that would carry a bowlder weighing a hundred pounds would not deposit a mass of clay.

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It may be suggested that floating ice dropped the bowlders, but even then there should be some assortment or stratification in the clay bank. Then ice only remains. Do the facts agree with this theory? They do in every respect, and so it may be considered a fact itself.

Then the teacher can tell something about the glacial period —the other reasons for believing in its existence, something of its extension and work, etc. Such an exercise as this will make the glacial period a reality and will sharpen the interest of the pupils, besides giving them some training in seeing and thinking for themselves. To gain this the student must be led to inquire and then to answer his own queries.

Again we go to the same creek for another and third excursion. A little down stream from the last locality the creek is cutting into a gravel bank, and just below this it has reached the shale rock through which it has cut a gorge. What is the cause of the gravel bank? Here again look for the facts. There is an assortment and an arrangement in layers. Pebbles of small size and various kinds are present, but they are rounded and there are no scratches. All causes but water can be eliminated, and this be shown to be in strict accordance with the facts. Compare with the present stream bed, in which the same conditions are found, even to a mixture of various kinds of pebbles from the glacial deposits; and the ice is probably indirectly responsible for the variety of pebbles. This study can be followed by a statement of the condition of the melting ice, the floods of water, the varying currents, and the abundant supply of rock fragments furnished by the ice.

Do these deposits bear any resemblance to any of the rocks previously found in the stream bed? Yes, the sandstone and conglomerate pebbles. How do they differ? This leads to a consideration of consolidation of sedimentary rocks. Perhaps one vent of the gravel bank is consolidated. Why? Water passing along has deposited a cement of lime or iron which has loosely bound the fragments together. Near by is a spring. Its water is hard, or it is charged with iron, some of which is

deposited as the water slowly runs away. Here is the key to the cementation of rocks. Underground water dissolving and depositing binds the rock particles together and makes sand into sandstone. The two are otherwise alike, and no sharp line can be drawn between them. The class can be told that the shelly beaches of the Florida coast are soon consolidated into a loose-textured rock, out of which houses may be built.

Going down stream to the gorge in the shale we find another lesson. The rock wall of the gorge shows an irregular face. Observation is directed to this face with the result that the irregularities are seen to extend horizontally, and that the sheets or beds are found one on another. The different layers vary in texture, but any single layer is moderately uniform in structure. Is there any resemblance to the gravel bed? Merely in the condition of horizontal layers. Of differences there are several. The layers of the sand bank are unconsolidated, they are very variable in texture and irregular in form. The reason for the consolidation of the shale is greater age, and perhaps the contact of gravel and shale can be seen in order to show that the shale is below. In any event fragments of the shale will be found in the gravel. What would cause the difference between the coarse and irregular sand beds and the slight irregularities of the shale stratification? The pupils can easily be led to show that only variations in rapidity of currents can be held accountable.

If time permits the joint planes can be studied and fossils can be collected from the rock. Later study of these shows the marked difference between them and the animals of the present. Here in this cut we have sedimentation with accompanying stratification, the entombment of fossils, an illustration of the fact that the lowest beds are the oldest, the induced structure of jointing, and at the contact of the shale and gravel an unconformity. What a wealth of illustration, and what possibilities in the training of observational powers!

Without exhausting the geological treasures of the little creek we may make a fourth excursion to it, going over the same

ground as in the last one. The stream has cut into the bluff of clay which is every once in awhile sliding down, so as to leave a fresh exposure constantly open to the air. Near the surface the clay is yellow, while below this it is blue. Here the surface waters have percolated into the dense clay and changed some of the iron to the yellow rusted form. This is one of the first steps in weathering. The roots of trees are seen extending into the soil at the top, and they are aiding in the work. The wind must blow fragments from the surface when it is dry; and that rain is wearing it away is plainly seen by the gullying of its surface.

Walking down stream a few yards a pebble is found with a roughened surface. Examining it, the indentations are found to exist where fossils are enclosed in the shale. Here is another lesson in weathering. Have a search made for similar illustrations in other pebbles. One of the larger granite bowlders is moss covered, and this agency of plants in weathering is there well illustrated.

At the gravel bank it is found that the material stands at a lower slope, and that it is more readily crumbling down under the attack of the weather than is the more dense clay bed. Thus we have an illustration of the influence of texture.

Going to the shale bluff we find that it stands nearly vertical because it is more compact than even the clay. What are the signs of weathering in the shale bluff? Why do some layers project while others retreat inward from the faces? What agents will aid in these results? What conditions in the rocks influence the weathering (joint planes, bedding planes, weak cement, easily decayed fragments, looseness of texture, etc.)? What are the differences between the weathered surface and the unweathered interior? Here we may see the importance of frost and of water which may even be seen slowly seeping out from a joint plane crack, or from a more porous bed. On the minor projecting ledges, and upon the top of the bank, the importance of vegetation is easily and clearly seen. The roots are seen entering the rock crevices, and a tiny plant torn from

the rock wall brings with it pieces of the shale. I am certain that an afternoon spent in such a study as this will do more toward interesting the pupil and giving him a rational knowledge of weathering than weeks of recitation and reading about this great process. It leads also to a consideration of the soils and their relation to the rocks—a relation not shown here, because the ice has removed it and left a glacial soil instead.

The possibilities of our creek are so far from being exhausted that I propose even a fifth visit to it. This time we go to the base of the gravel bluff, from which we can look down into the shale gorge. Through the trees on the right a gently sloping hillside rises to a divide a mile distant and at an elevation of 500 feet above the creek bed. The problem is to see how a valley two miles wide and 500 feet deep has been cut out of the shale by the tiny stream.

In the first place can any other explanation be advanced for the valley? It may be of glacial origin; but this is not possible because it extends diagonally to the direction of ice motion, and its tributaries of the same form enter it at various angles. Great floods may have washed it out; but floods would hardly have cut out a series of arborescent streams over all the country and still have left no signs of their presence. Perhaps the valley is one of faulting, but against this is the fact that the shale layers extend uninterruptedly across the valley. Possibly the surface has gaped or cracked open without vertical movement on the two sides. There are no signs of this and no reason for believing it. We know of no such cracks now forming or recently formed. If they have existed they have left us no evidence of their existence, and it is strange that the tributaries and main stream should have valleys which meet exactly as do those of rain-born rills on a road or on a beach. Each of these theories has been suggested for river valleys by former geologists, and some of them were long held and strenuously defended; but now they have no supporters, for long and careful studies in various parts of the world have proved their insufficiency.

At present the stream is so narrow that it can be crossed

with a jump, and so shallow that it can easily be waded. What is it doing? So far as we can see, nothing. Even sand and clay are undisturbed by the gentle current. However, the water is "hard," and this shows a perceptible amount of chemical load. Every cubic foot of water is carrying its load of dissolved mineral obtained from the bed and the banks. There has been no rain for days—then where does the water come from? A spring emerging from the base of the gravel hill near by shows the source of the permanent water supply and also of some of the load of dissolved mineral matter. This may be followed by a discussion of the importance of underground water.

Is this present quiet condition of the stream a permanent one? All have seen the raging torrents of spring and summer when the water is laden with mud; and at our very feet the large rounded pebbles of the stream bed are witnesses of former violence. So at times the stream is a powerful worker, and it is always doing a little work. What would result from this alone? Naturally a deepening of the valley along a rather narrow line not a great deal wider than the high-water stream breadth. Meandering slightly widens the valley and this is shown both in the clay bank and the gravel bank at the base of which we are seated. Then how did the valley gain a width of over two miles at the top? Here comes in the action of weathering and the application of the knowledge gained in the last excursion. The close of the glacial period during which the gravel bank was formed is estimated at from 5000–15,000 or more years ago. In all this time denudation has not succeeded in removing a low deposit of loose sand. Then how much more vast has been the time required to carve out and broaden into maturity a valley as great as that in which the creek runs! Granting the necessity of the explanation, the student gains from this excursion a more nearly adequate conception of the immensity of geological time and the grandeur of the result obtained by moderate action with plenty of time than he could possibly hope to get from mere reading.

The creek is flowing slowly in a rather broad amphitheater

enclosed by drift hills; then just below us it has entered a gorge in the shale and is leaping over the bed in a series of falls. Why is this change? The evidence at hand shows that the preglacial valley is partly obscured by glacial deposits through which the stream is cutting a channel, but not always directly over its old bed. Where it enters the shale it was turned over to one side of the old valley, and so is cutting a gorge in its old bank. This narrow gorge, therefore, shows a young valley which may be contrasted with the great preglacial valley. At the falls erosion is rapidly proceeding, but weathering has hardly had time to accomplish notable results. This part of the excursion furnishes abundant opportunity for amplification, and also for a statement of the development of river valleys, and of the effect of the glacier upon stream courses. Both here and in later class-room work these observations furnish a chance for frequent reference in illustration of many points which come up from time to time in the recitation or lecture.

We could make the sixth excursion to the same creek, but will follow a road which leads up the side of another one. A pair of level-topped terraces face the stream. What is their origin? They may be built up in lake water by a damming of the stream; or they may represent ancient flood plains at a time when the stream carried more water; or they may have been cut out by the stream when it was larger; or the cutting may have been done by a stream of the present size which has meandered from one terrace base to the other.

Going on a short distance we see a series of three lower terraces on one side of the stream and none on the other. A cut by the road shows that the top of one of these is composed of coarse cobble stones like those in the stream bed. Looking at the structure of the large upper terrace we find it to be made of bowlder clay. This disposes of the first two explanations, for they would demand stratified water deposits. Moreover, the top of the terrace slopes down stream, and hence is not a lake deposit, and its surface is too irregular for a flood plain. It is therefore a case of excavation; but was it done by meandering,

or by a constantly decreasing stream? The cobble deposit on the top of one of the terraces would favor either theory; but the absence of the smaller terraces on one side of the stream would stand opposed to the theory of decrease in stream volume. A little farther on we see an abandoned curve of the stream at the base of the main terrace of the right bank, while the stream is now cutting in at the base of the opposite terrace. Going still further we see other illustrations of a similar construction of terraces, and we thus gain facts favoring the one theory rather than the other, but not absolutely disproving the less favored explanation. It is well that this is so; for science abounds in problems which are now exactly in this stage. We have not yet been able to prove everything, and early instruction is entirely too apt to confuse theory and fact. Many a student has learned as a fact an explanation which he later learns to be a very insecure theory. Even scientific men are sometimes thus confused, to the detriment of scientific progress; and it is well early to impress the fact that there is yet much to learn and much that is only partially understood.

Our seventh and final excursion is to the shore of the lake which extends north and south, and we proceed along its eastern side. There are some high bluffs of shale here and low over on the opposite shore. From this we learn the greater power of the west winds, and we see the action of the waves in undermining the cliff. At the base of the cliff is a beach of shale pebbles now in the mill of wave action; but there is no clay such as would be produced by grinding shale fragments together. It has gone off into the lake and is helping to fill it up. In a little bay we see plants growing on the bottom and at its head a swamp, illustrating the agency of vegetation in lake filling.

A short distance beyond is a projection into the lake, a delta at the mouth of a stream which is filling the lake more rapidly than the mere wave action. The delta is dry and well above water, and one of the reasons for this is seen at the shore where the waves of some storm have piled the fragments to a height

several feet above the lake level. A second reason is that in time of flood the stream overflows its delta and builds it up, raising it higher on the landward side because it is nearest to the source of the water and gravel. The stream cuts the delta into two unequal parts, flowing on the northern side. Again an effect of the strongest prevailing winds which drive the delta materials to the southward.

So far the pebbles of the beach have been well-smoothed but flat bits of shale. We now come to a beach where the pebbles are rounded in form and varied in kind. Looking to the shore we see a low bank of bowlder clay in place of the shale bluff. Here is a river valley buried beneath glacial drift, a common feature in many glaciated regions. The cause for the variety and roundness of the pebbles is discovered in the glacial deposit. We could go along the shore and find other features, but probably enough has been said to indicate the class of work that seems most generally available and desirable.

I have not attempted to enter into difficult or unusual field illustrations. They are much better left until after a simpler beginning has been made. I would urge simplicity rather than complexity, for the complex is much better understood when based upon a well-formed understanding of simple phenomena.

Many who read this may say that the localities described above cannot be duplicated in their vicinity. This is very true; and yet there is hardly a place in the country where similar if not the same phenomena are not at hand. Until one has looked carefully around him with this idea in mind he can hardly realize how many really excellent and simple illustrations of geological and physiographic facts and principles are on every hand. Even the water that runs from the gutter of the schoolhouse has a lesson for study. So I would urge as the first principle of field work that the teacher should spend some time in careful study of his own neighborhood. If he does this he will meet with success in his search, wherever he may live; and then, if he will follow the method indicated, he will teach more real geology and physiography than the text-book can impart. Let him find some

places for excursions, arouse the interest of his pupils, lead them on to observation, discovery, and sound reasoning, and he will make of this part of his course a study worthy of a place in the secondary school.

As a final word of suggestion I would repeat what I have said in a previous article. Avoid turning the field day into a picnic; but in the attempt to avert this evil do not err by going as far in the opposite direction. Keep the mind constantly alert and direct the bright and the dull along the difficult path which leads to the power of individual seeing and logically concluding. Become a severe but friendly critic, ruthlessly pointing out fallacies or incorrect observations; but then follow the destructive criticism by a leading suggestion. The result of the study may be one of discouragement or encouragement according to the attitude and tact of the teacher. If the former results, then harm is done and the work had better be abandoned; if the latter, then encouragement is followed by eager interest which may even amount to enthusiasm. This result and the training that necessarily goes with it is certainly worth an effort; and if the science of geology and physical geography are going to maintain a place in the curriculum, they must establish for themselves some claim for recognition besides the mere mass of information which they impart. The claim is easy to establish, and all that is needed is intelligent effort on the part of the teacher; and given this it will soon be found that these subjects have merits of their own, so important and unique that the secondary-school curriculum that does not contain them has an important gap unfilled.

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PHYSICAL GEOGRAPHY IN SECONDARY SCHOOLS

THE plea of this paper is that physical geography including the history of land forms should have an established place in secondary education. This cannot mean less than one year of sustained work, so pitched as to demand the best powers of the student. In emphasizing the physiographic phase, we do not exclude, but rather require, in their higher aspects, the other departments of physical geography. Here falls organic distribution as understood only on the basis of geographic evolution. To know how oceans and continents, plains and mountains, have come to be, gives ground to understand environment and migration, with the means by which the latter is affected, and the limitations to which it is subject. Meteorology also is essential, at once affected by and influencing topographic development, and dealing with natural events which are of daily interest to man. Commercial geography, too, will have a fuller interpretation than is possible in the grades, and physical environment as controlling history in its critical stages, will yield the ripest fruit of geographic study.

This scheme involves progressive instruction in the lower grades, in simple dynamic agencies and results, in the forms and habits of animals and plants, in the distribution of land and water, and of all geographic units, physical and political, all as far as possible taught in a causal and rational manner, from the things themselves, or the best obtainable representations of them.

I propose to urge my thesis chiefly upon its claims for culture, and under two heads, information and discipline.

Here is a great body of facts about the world in which we have our home. These facts do not merely supply essential knowledge for our daily conduct, they enlarge the mental horizon, add to our dignity and sense of responsibility as citizens and

rulers of the world, and in a large way help us discern and handle the problems of life and society. No man is prepared to think truly, who does not in some measure appreciate the world and its organisms as evolutionary. We deal with facts, but with facts genetically related, and hence not nakedly informational. We study concrete things, to be sure, but in the light of their history, and as having their goal in man. For this point of view the secondary school has no resource but geography. If we seek illustrations they are legion — the origin and development of our planet, in its larger features, the making and meaning of natural scenery; soils, economic minerals, and all earth resources. What right has the school to leave any mature pupil ignorant of the nature of coal and of the geographic conditions of its origin? Can anyone weigh the saving to this country, if the farmer and the legislator understood the prolonged genesis and the supreme value of soils? How many know that a building stone ought to have in a wall the attitude which nature gave it in the quarry? Had the woman been taught geography, who, having seen the caterpillar mountains of the conventional map, spoke of the Ontario and Western railway as running along the base of the Catskills? I have seen college students surprised to hear that the hills of the Alleghany plateau in central New York were not the result of deformation. How large is the loss to the citizen of the northeastern United States, who has no eye for glacial topography, and to whom the varied and impressive structures of the ice time are Greek, or more likely have elicited no inquiry whatever. The complex functions of a river, the structures that border it, the fascinating chapters of its history, are material of rational geography, falling daily under the eye of man, and, if understood, enriching all his thought. Lead a boy to inquire why Chautauqua's waters seek the long way to the gulf, instead of spilling over into the adjacent Erie, then show him how the Allegheny, and perhaps the Monongahela, once drained northward, and you have widely extended his mental view. Finally, initiate him into the principle of the base level, show him that all land surfaces tend toward that goal, display before him the

forms that intervene, and the vicissitudes that interrupt the process, and you have given him a range of information that runs all the way from the severely practical and utilitarian to the distant and the ideal.

But geography is a discipline. In a rarely complete and symmetrical way the mental powers are brought into exercise. The old geography taxed the memory. The new geography trains the memory, not by loading it in an arbitrary manner, but by the association of materials of infinite variety by a causal bond which will not admit of dissipation as soon as the pressure of will and the stimulus of impending examination is removed.

In its service to the observational capacity and habit, geography is not behind any other science. Here the deficiency, even among educated people, is startling. And it is especially when out of doors that they see and do not perceive. The average man has no sense of topography. He cannot tell time by the sun, is in peril if left alone in the woods, could not describe the clouds which he saw while the storm was coming up, or give a true and vivid account of a ride in the country. Schooled to the last degree in other disciplines, he has been blinded to mother nature and is an orphan in the midst of his home. The very savage has a keener eye and a deeper love of wood and field than the supercivilized and dull-eyed child of the humanities. I shall not forget the good woman *en route* among the Rocky Mountains, who had lived a year in Grand Junction and thought it was situated to the south of Denver. It is in the training of the observation that representative geography, and all forms of laboratory exercise in geography, have the largest value.

It is, however, in the exercise of the reason that geography offers its best service as a discipline. To run from effect to cause, from cause to effect, to compare, to judge, to classify, is the unceasing prerogative of geography. It is of less worth to know the area and tonnage of the Great Lakes than to know something of their history. The materials for such instruction are now available to the alert teacher. Successive stages in their history are inferred from a series of elevated shore lines.

The passage of a beach into a moraine in western New York argues water in one part of their basin and ice in another. Varying levels of the same shore line prove subsequent tilting of great areas of country. Various considerations argue for and against the presence of marine waters in the earlier stages of the history. To bring this single theme to the understanding of a high-school class would be to them a revelation, for it does not occur to one man in a hundred that these bodies of water are the result of physical history, much less that the chapters of the history can be reasoned out and made to live again.

A not difficult study of the Hudson River and valley will lead the student along lines of logical certainty to important and keenly absorbing conclusions as to earlier geographic conditions. Take also that great field scarcely scratched by tillage as yet, the relation between physical environment and national development, "Man is what he eats." Let us make it broader than that—man is, *where he lives.* To trace out such connections is the business of geography. We shall sometimes blunder, but we shall find a sure substance of truth. Rossiter Johnson says that secession was an attempt to make two sovereignties where there was no natural barrier. Let the teacher get hold of that truth. Let him seek for comparative facts. "The kingdom of Poland passed out of existence because it had no natural boundaries." Contrast Greece, Spain, Switzerland, Scandinavia, Great Britain. Follow up the relations between mountains and history, or shore lines and history, and see how fruitful it becomes for the reason and for the whole intelligence. Trace the isothermal of 48, in at Cape Ann, across New England, southward into Georgia, straight north into Ontario, west by Detroit and Chicago and the Black Hills, south into New Mexico, far north again, south around the Pacific mountains, north and into the western ocean at Puget Sound. How profound the bearing of this elaborate curve upon the economics and history of the United States, and how rich the field for rational teaching.

Some one has said in substance that whatever increases our

interest in that which is remote in time or space enlarges our culture and promotes our dignity as thinking beings. We emphasize, indeed, home geography, not chiefly because it affords convenient knowledge, such as how to drive to the next town, but because it unfolds principles, yields types, and helps us conceive the larger and the unseen. To come to the point, no other school subject so exercises the constructive imagination as does the new geography. The pictures of other continents and of other times must be sketched and colored by rallying the student's highest powers. This means a high order of teaching, but of this we are not now speaking. Give appreciation of the subject and this will raise the order of instruction to its proper level.

We emphasize here the historical and time sense. The earth is not dead. There are no "dead" geographic forms. There is not even stagnation. The earth never hibernates. When Mark Twain was a cub pilot on the Mississippi it distressed him that he must learn 1200 miles of river. Then he must learn it both ways; must know it at noon and know it in midnight darkness. Then when he has learned it, he said, "won't it go fooling around?" Ah, precisely that. The earth is all dynamic, vital, evolutionary. It has been so for eons. Geography is not taught till this conception is gained. Here in the secondary period is your only opportunity to give this vastly important sense of duration, of events transpiring upon a background of infinite time. You cannot tax children in the grades with it. They cannot receive it. You cannot depend on courses in historical geology, or on the college, for most will have experience of neither. Rational geography will give this rich enlargement to the intellectual life, and go far to wean it from the narrow, the conventional, and the untrue. Here is your opportunity to gather up the ripest fruit of the most pervasive and most educationally pervasive, doctrine of our time, evolution.

The æsthetic and moral value of an introduction to genuine geography enforces its claim in no meager fashion. These

considerations emerge naturally in this field. The world is a constant and high revelation to him who holds its secret. Nature as affording refinement and repose for all, must be interpreted to the scholar, else his education is partial and without symmetry. This is the one science whose materials of observation are at hand throughout life, though balance and measuring rod, and microscope and books be absent. In this field, therefore, knowledge may, after preliminary training, grow almost without effort. It is a tree which must grow tall and send out spreading branches when once the seed has germinated. Form, proportion, arrangement, and color are the perennial lessons of geography to the appreciative spirit. The delight afforded by the beautiful and true in nature is a valid educational motive. Here is the needed repose of body and soul in the rush of modern life. Here, too, is soil for purity and moral purpose. With singular unanimity eminent men and women have summed up the influence of Niagara as a sense of peace for the spirit. Some one, perhaps Emerson, touched this moral quality of things when he said, "Nature is loved by that which is best in us." The geologist Ramsay, taking his nooning in the presence of a far view on one of the Welsh mountains wrote, "As I looked, I felt my heart soften, and I rose a better man again." Russell, daring, and all but conquering the heights of Mt. St. Elias, said: "The fortunate traveler who stands on these commanding points in brilliant weather will have a charm added to his life of which no changes of fortune can deprive him." And Whittier, fully appreciative of the curative power of the world where man finds his home, wrote:

> "How the eye and ear
> Are starved amidst the plenitude
> Of nature, and how hard and colorless
> Is life without an atmosphere."

Geography then is not a bread and butter theme, though supremely practical. It is not chiefly an informational theme, though rich in store of fact. It is not an easy nor a dull theme, but full of substantial difficulty, and throbbing with interest.

Because it makes so broad an appeal to the eye and reason, to imagination and taste, it commands interest and asserts thus its pedagogical value. The common mind can be counted on when common things about the earth are explained by one who knows and loves them. Not seldom will the teacher have his reward in being told that to a young man, his native hills and valleys, and his travel over the world, will have, henceforth, new meaning for him.

I have asserted the educational value of geography in no measured terms. I have hinted at a geography which is too advanced for the grades, too important to be omitted, and which most will not reach in college. This testimony is not without strong support. Says Archibald Geikie: "I long have been of opinion that geography in this sense of the term ought to form an essential part of education. It ought as a matter, of course, to occupy a distinct and important place in the curriculum of every high school." Keltie, in his well-known report, says of geography in Germany: "It is a serious subject of education, legislated for by the government, and taught to a large extent by trained teachers." It was Kant who wrote, "Nothing is better calculated to awaken the healthy human intelligence than geography." An English schoolmaster writing of physical geography says: "It was eagerly studied and brought out unexpected enthusiasm in some of what were thought the stupidest and laziest boys." Superintendent A. F. Nightingale enumerates physiography among the subjects which "are no longer to remain in the category of informational studies and suffer the opprobrium of being contrasted with the humane and the literary as the sole dispenser of intellectual culture." Mackinder said: "A worthy geography is no pariah among intellectual disciplines." And finally I quote the Committee of Ten, "There can be no doubt that the study (as proposed) would be interesting informing, and developing, or that it would be difficult and in every sense substantial."

Much has been made, and sometimes, I think, in unbecoming fashion, of the admission of the conference report to the

Committee of Ten, that the literature of geography was not in good form. This is much less true today than when the report was written, and is but best a temporary consideration. There is too much geology in it, say some. I reply, not over much,—and add, that between the geology and the geography no sharp line can, or need be drawn. The geologist is bound to teach some geography from the geologic point of view, and the geographer must teach some geology from the geographic point of view. Students of nature ought not to grumble because hard and fast lines are not found. Nor does Professor Palmer's objection hold, that strong courses in physics, chemistry, mineralogy, and biology are pre-essential to physiographic work All of this is desirable, and much of it is necessary to the teacher, but the pupil is not to be denied rational geography till he present this preparation.

Where then shall we put geography in the high school? On this I defer to experienced makers of secondary programmes, but I urge again that it will not do to put it into the first year on sufferance, waiting for developing "science in the grades" to pull it down to a lower horizon Better send it forward to the third or fourth year, and get first as much as possible of the physics, chemistry, and biology which all of us agree with Professor Palmer in counting important.

And if the same authority will allow me to criticise him again, I challenge his so-called "expensive waste of time on the physiographic studies," and "finishing course" though it be, and urge again the needs of that vast majority of high-school graduates who will not go to college but who will constitute the enlightened society of our time. The culture offered by the new, rational, and higher geography is too broad and too precious to be denied to this great body of educated men and women. That we have not yet a competent body of teachers I grant, but this too is a matter of brief time. And we must not forget that geography cannot be taught in the grades until the grade teachers get it in the high schools. The universities will equip the high-school teachers, and they in turn will do like service

for those below them I have no fear for geography. It is a safe principle that no doctrine in theology and no discipline in education will be lost if it ought to survive. "Truth is a good swimmer." The writer was trained to the classics, and the most conservative stickler for Greek and Latin could find no fault with his bachelor's degree. Everyone knows that Greek and Latin have grown green in the new educational freedom. They are no longer dead, but have become living branches of the tree of knowledge. Latin could not be put out, and geography cannot be shut out. Taught rationally in the grades, it asserts its rights in the secondary school, and holds its distinctive ground in the college and in the university.

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HISTORY AND GEOGRAPHY IN THE HIGHER SCHOOLS OF GERMANY

II[1]

The programme for the second part of the work in history and geography is as follows:

QUARTA: 4 hours. (*a*) Geography of the Balkan peninsula, the Carpathian countries and Asia, particularly Asia Minor; Grecian history to 146 B. C. (*b*) Geography of Italy, Spain, France and Africa, especially northern Africa; Roman history to 476 A. D.

UNTERTERTIA: 3 hours. (*a*) Geography of central Europe with special reference to physical characteristics and political history; German history to 1096 A. D. (*b*) German history from 1096 to 1555; outlines of American Geography in connection with the history of discovery.

OBERTERTIA: 3 hours. (*a*) Modern history from 1555 to 1700; the geography of Great Britain, the Scandinavian Peninsula, Denmark, France and Russia; review of European geography. (*b*) Modern history from 1700 to 1815 and from 1864 to 1871; geography of America and Australia and of the German Colonies.

The most important deviation from the Prussian course that appears in the Jena *Lehrplan* is in the amount of time devoted to the history of Greece and Rome. The Prussian plan, as has been stated, gives but two years to this work—one in *Quarta*, when the pupils are but twelve years old, which covers the whole field of classical history in a single year of two lessons per week; the other year is in *Obersecunda* during which all of Greek and Roman history to the fall of the Western Empire is done in three lessons per week. Further than this there is nothing of classical history,

[1] Continued from the May number of THE SCHOOL REVIEW.

not even a review in the last year of the course. The Prussian *Lehrplan*, as has been previously mentioned, has been arranged with a view to the practical needs of those who leave school at the end of a six years' course (about 40 per cent. of the entire number); and it has been considered especially desirable, therefore, that they should take with them a well-rounded training in the language, literature and history of Germany, and in religion. Hence the Grecian history formerly taught in *Untersecunda* has given way to an additional year of modern history. Few other German states have adopted the Prussian plan to this extent. There are undoubtedly certain practical advantages connected with it, both in the emphasis placed on modern history and in the division of the work made for the benefit of those who do not intend to complete the school course. Still the classical schools feel that in the time allowed it is impossible to teach Greek and Roman history satisfactorily. From a pedagogical standpoint there is no doubt that the Jena plan, which is the one generally followed in the other German states, has superior advantages for the classical schools. Although the second part of the course is completed with *Obertertia*, it provides for a more intensive course in the upper classes, one half of which is devoted to the history of Greece and Rome.

The work of *Quarta* begins with a review of the most important Greek legends. Nearly all schools give a year to the mythology of Greece and Rome—in Prussia, *Quinta*, and in other states generally, *Sexta*. In Jena, however. the work is confined for the most part to stories from the Odyssey which also form a part of the German reading course. The wanderings of Ulysses demand a careful study of the geography of Grecian lands. Maps are drawn of the Balkan peninsula and Asia Minor; the islands of the Ægean are located; and the classic routes of travel compared with those of modern times. Then follows an outline history of the political events in Greece between 1104 and 500 B.C. together with the necessary changes in the geographical divisions. The study of the Persian wars bring in the geography of Asia and Egypt, and the biographies

of Cyrus, Cambyses, Darius and Pericles. The account of the Peloponnesian War is accompanied with a study of the geography of Sicily. Then follows a narrative of the events clustering about the lives of Socrates, Agesilaus, Epaminondas and Pelopidas, Demosthenes and Philip of Macedon. The story of Alexander the Great, the division of his empire and its subsequent subjugation to Rome completes the historical course in Grecian history, and also furnishes an opportunity for a review of the geography of southwestern Asia. The work of the second semester is Roman history and a study of the geography, ancient and modern, of the countries included in the Roman Empire. The class at the same time that it is studying the history of Greece and Rome has the geography of Palestine in connection with religion, and is reading in German the Theban legends, stories from Greek history, Schiller's Cranes of Ibycus, stories from Roman history and travelers' descriptions of Italy and Athens.

In *Untersecunda* the history of the Holy Roman Empire is traced down to the year 1555. So far as possible the social and political changes are treated with reference to the fortunes of the city of Jena, which lies at the crossing of the two great highways contended for both by the Germans and the Slavs. Within sight of the town are a dozen castles and strongholds each of which has a story to tell of the struggles of these races for supremacy. The history of the city church and cloister, of the city hall (Rathaus) and of the market, dates from early times and illustrates the gradual development of local self-government. The founding of the university and its later history afford a natural means of introducing the study of the Reformation. The political and physical geography of central Europe afford important contributions for the understanding of the course in mediaeval history. The period of discovery brings in America, south Africa and Asia.

In *Obertertia* the chief events of modern history from 1555 to the present time are considered. It is the period of colonization in which England takes a leading part. Queen Elizabeth

is portrayed, and the geography of Great Britain is studied. The Thirty Years' War brings in Sweden and Denmark under the hero Gustavus Adolphus. The French influence in the seventeenth and eighteenth centuries necessitates a study of the history of France as it centers in the career of Louis XIV. Russia, as represented by Peter the Great, is given some attention. The second semester is devoted to the history of the eighteenth century and the culmination of events in the overthrow of Napoleon, and in the final restoration of the German Empire. A study of the German colonial possessions, and of those countries enriched by German immigration, gives ample opportunity for a review of the geography of the world. During this year the class reads in German selections from Schiller's *History of the Thirty Years' War* and from his *Wilhelm Tell* both of which are sidelights on the work in history.

There has been much discussion concerning the best methods of teaching history in the middle and upper grades. Teachers have pointed out the defects of the narrative method and maintained that thereby scholars attain no power of independent investigation; that even the faculty of discriminative judgment is not properly cultivated; and that few pupils ever acquire a love for historical reading. Professor Schiller, of Giessen, a noted writer on gymnasial pedagogics, still holds that it is highly desirable to assign readings to be done out of school and to devote the lesson period to a discussion of the topic. The Prussian regulations, however, distinctly prohibit the general adoption of this method because of the restrictions it places upon the free time of the pupils. From twenty minutes to half an hour a day is all that a teacher has a right to expect of his pupils by way of home study, and this is hardly sufficient for the correction of notes and the making of such maps as are necessary in class work. In fact there is but one method possible for the German teacher. He must himself narrate the stories, make outlines and do the reviewing in the class.

The method of presentation in the middle grades does not differ materially from that already described in the lower grades.

First there is a review of the important events of past lessons; then the telling of the new story and its oral reproduction by the class according to the outline which the teacher has developed and placed upon the board. Text-books are commonly used, of which there are many excellent varieties. They are, however, mere outlines which by no means usurp the function of the teacher. They are handbooks for consultation in review and for fixing lessons already elaborated in the class. A text-book that presumes to give a complete account of the historical development of the period studied would be worse than useless to the pupil. He would not have time to do the required reading, to say nothing of sorting out the important facts. For pupils' use a concise reference book rather than a text-book is required.

The Jena programme for the final course is as follows:

UNTERSECUNDA: 3 hours. (*a*) Review and continuation of Grecian history down to 338 B. C., with reference to the ancient geography of Greece and Asia Minor. (*b*) Alexander the Great and the Hellenistic Empire down to its subjugation by Rome, together with a geographical review; then a review of Roman history to 133 B. C., and of the geography of ancient Italy. Geographical reviews of Asia and Africa.

OBERSECUNDA: 3 hours. (*a*) Roman history from 133 B. C. to 375 A. D. (*b*) Mediæval history to 1056 A. D. Geographical reviews. Review of important dates in the world's history.

UNTERPRIMA: 3 hours. (*a*) History of the period from 1056 to 1555. (*b*) Modern history from 1555 to 1786. Geographical reviews.

OBERPRIMA: 3 hours. (*a*) Modern history from 1786 to 1888 with special attention to geography. Comprehensive résumé of the historical development of modern civilization.

The methods to be followed in the upper classes do not differ essentially from those already outlined. The pupils are more mature; they have read more extensively from both classical and modern authors and have greater power in abstract

thought. Nevertheless the same general plan of presentation must be followed as in the lower classes, the only difference being that less effort is required to make the work interesting, and more attention can be given to the relations of cause and effect. In fact this final course does not cover much more ground than the one just finished; but it is treated in a more general way, and the causes of political changes are emphasized to the exclusion, in a degree, of the descriptive work which characterizes the earlier course. The pupils already know the more important facts; the main thing now is to search out the reasons for their being. In *Untersecunda*, while the history of Greece and Rome is being studied, the class work in religion is concerned with the apostolic history and the founding of the Christian church. In Greek, Xenophon's Anabasis and selections from the Odyssey are being read, and the connection is maintained throughout the following year by readings from Herodotus. Early Roman history is supplemented by reading Cicero's *de imp. Cn. Pompei* (alternating with *pro Roscio*), Virgil's Æneid Books I–III and selections from Livy, Books I, II, III, V, VI, VII, and IX.

In connection with later Roman and mediæval history to 1056 the *Obersecunda* class reads in Latin several books of Virgil and selections from Livy, Books XXI, XXII, XXV, XXVI, XXVII and XXX. The work in religion is confined to the apostolic period of the church and the mission of Paul, which afford excellent opportunity for bringing together important facts in history and geography.

In *Prima* the course in religion develops the history of the church through the Reformation down to modern times. The class by the study of *Nibelungenlied* in the original text and the middle high German literature, which is a part of the work in *Obersecunda*, is now ready to read the *Germania* of Tacitus. And with this course the climax of interest in German antiquities is reached. The gulf between the present and the past is effectually bridged over; the German school boy henceforth feels that ancient history is very real.

The course as outlined for the Jena *Gymnasium* is perhaps the best illustration of recent attempts to correlate the instruction in the humanistic subjects in the secondary school curriculum. The Prussian *Lehrplan* is by no means so carefully adjusted in this respect; nevertheless it would be difficult to devise a curriculum for the German schools, considering the available material, in which one subject did not bear some relation to the other subjects of the course. In Jena there is not only the external correlation, but there is an even more serious attempt to make the instruction of the class room effective in more directions than one. The Jena curriculum as it now stands is the result of many years of study on the part of a large number of schoolmasters. In this work, as has been said, Dr. Frick was the leader and the Jena curriculum is today perhaps the best example of the fruit of his work and the labor of his colleagues.

In conclusion, I find it difficult to estimate the worth of the German methods of teaching history. The geographical instruction has always seemed to me most excellent, but there is room for wide differences of opinion with regard to the work in history. In certain schools which I could mention the work is undoubtedly of a high order; the scholars are deeply interested and the results are eminently satisfactory. Still it must be remembered that in many schools—I fear in the great majority of them—the work is purely formal and disconnected, unrelated, and exceedingly uninteresting. The successful teacher, according to the German method, must be an able storyteller and have the power to stir the emotions of his pupils by the narration of historic events. He must be enthusiastic and possessed of encyclopædic information. When these conditions are not fulfilled there is a dry recital of events which is followed by a still drier recitation by the pupils. A few facts may be learned, but so long as they are not related to other facts they are lifeless. I confess to having heard lessons—many of them—which were soporific in the extreme, and so unusual was it in my experience to find a good teacher of history that I often despaired of seeing the German system at its best. Teachers continually complained

to me by way of excuse for a poor showing that no time was allowed for outside study, and that with only two or three lessons a week it was impossible to get good results when everything depended upon the teacher in the class.

On the whole I was greatly disappointed in the practical working of the German methods. Comparatively few teachers, it seems to me, have the ability or the disposition to treat the subject in the only way that can bring success. Germans are not natural storytellers; as a rule they are too phlegmatic. Success for the average teacher, therefore, depends upon his ability to systematize and arrange his material in such a way that at the end of the course the pupil has a definite, closely related body of knowledge. Lack of interest on the part of some and lack of methodical arrangement are, it seems to me, the two great factors which account for the unsatisfactory results in the teaching of history in the secondary schools.

It is still a fact, however, after all is said that the German students who do their work at all satisfactorily generally have upon the completion of their course a very comprehensive view of the world's history. They are familiar with the chief events in history from the Trojan war to the accession of William II.; they have traced the development of political geography for some three thousand years up to the present; they know the topography of the countries in which the great historical scenes have been enacted; they know something of the physical conditions which have determined the economic characteristics of various nations; they have been led to notice the changes that have taken place in historical times in the relations of the industrial life to the family, of the family to the community, and of the community to the state. Finally, the influence of art and literature upon the development of civilization is tolerably clear in their minds. They may be deficient in the ability to make independent historical investigations, or even be unable to read intelligibly certain historical works of a technical nature, but they have nevertheless what may be called a historical instinct. They may not be able to account for the faith that is in them but

they have the faith notwithstanding. Such students when they go up to the university very quickly become acquainted with the methods of doing research work; they easily adapt themselves to circumstances, and become what may be rightfully termed students of history. It should be understood, however, that the patient industry, the dispassionate judgment and breadth of scholarship that are exhibited by the typical German historians, can scarcely be credited to the study of history in the secondary schools. I am disposed to believe that the courses in Greek and Latin, in German and in religion, furnish the muscle and sinew: the historical course builds merely the skeleton.

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OUTLOOK NOTES

THE DEPARTMENT OF SECONDARY EDUCATION AT MILWAUKEE

For a complete report of this meeting everyone may be referred to the official proceedings, now in type, and to be issued this year more promptly than ever before. Only a few salient points will be touched upon here. The sustained interest in the department was abundantly shown by the attendance and the character of those who took part in the various programmes. But the membership of the department this year was almost totally different from that of last year. That is the saddest part of these meetings. It is so hard to shape any fixed policy of development, let alone carry it out, with a constituency more constantly shifting than the waves of the sea. Interest centered this year, as last, about the report of the Committee on College Entrance Requirements. This was a fine meeting, yet not, it must be admitted, so stirring as that of last year. Nor is the reason far to seek. Those present were practically unanimous in accepting and approving the work of the committee, including in this approval the plans for future action. This report has been most unjustly criticised by some persons who betray in their criticisms a total ignorance of the subject they criticise. It has been said that the report was disappointing as compared with the report of the Committee on Rural Schools, for example. So is the Mississippi at its source disappointing as compared with the Potomac at its mouth; therefore, according to these critics, the Potomac is the largest river in America. The Committee on Rural Schools, like the Committee of Fifteen and the Committee of Ten, has spent several thousands of dollars of the association's money, whereas the Committee on College Entrance Requirements has not had as yet a single cent from the association. Moreover, the report was simply a report of progress, and as such could not fail to convince reasonable

and well-informed people of the quite exceptional success that has attended the efforts of the committee to arouse and maintain a widespread interest in the work and to secure expert coöperation in bringing that work to a wise and helpful conclusion. If the N. E. A. treasury is in such a condition that the committee may receive a small appropriation, the final report can probably be presented next year. It would truly be a pity if the work so far accomplished by the committee should not go on to full success for lack of the small sum of money needed. The officers of the department for next year are George B. Aiton, President; Mrs. May Wright Sewall, Vice President; E. G. Cooley, Secretary. In their hands the department is sure to hold what it has and make a substantial advance. It is to be hoped that they may find a way to make the Round Tables truly Round Tables. They are a valuable feature, as they have existed the past two years; but, after all, up to the present they have been really subdepartment meetings. The difficulties in making a real Round Table are, however, not inconsiderable, when all the speakers on a given programme are liable to fail at the last moment, leader included. This actually happened at Milwaukee in the case of the Round Table on the "High School as a Social Factor." Superintendent Dutton undertook the day before the meeting to make a new programme, and succeeded so admirably that it became a fair question whether all programme making might not well be left until the day before.

WHAT OF THE NEW YEAR?

TEACHING is far more nearly a true profession with secondary teachers than with teachers in the lower grades. High-school and academy teachers are often enlisted for life. They owe, therefore, a higher obligation to their calling than do the volunteers for a year or two. They also owe more to themselves. They can be no greater in their work than they are in their personalities. As they act upon their environment, so it reacts upon them. To them are committed the most priceless of the nation's possessions — those young men and maidens who are not content with the modicum

of knowledge needed by the humblest to win the most modest share of daily bread, but who dare to aspire. Their aspirations are vague and unformed; the secondary teacher has the privilege of shaping them. "Whose superscription is this?" the world may ask of the man or woman, and the answer is, the secondary schools'—not the colleges' nor the universities'. The battle of Waterloo was won on the playground of Eton, said Wellington. He did not say in Oxford or Cambridge. All these things we secondary teachers have known so long that some of us have forgotten them. Old truths need restatement occasionally. Only as secondary teachers are alive to their great opportunity and unusual responsibility in drilling the recruits of culture can they have that vital interest in their work which makes that work joy and privilege instead of deadly drudgery. Then, too, the field of secondary education is full of problems. Let us hope it always will be; for of all things distasteful to a robust American static perfection is the worst. Old problems must be attacked from new standpoints; ways must be found of solving the newest problems; all that is new and helpful must be found and used. Teaching ought to be the last thing in the world to become dull and monotonous. It may become fatiguing, but there is no good reason why it should become uninteresting.

WHAT IS AN ANIMAL?

EDITOR OF THE "SCHOOL REVIEW."

Recently, while teaching biology in a secondary school, I received some rather curious answers to the question,—"What is your idea of an animal?"—a question I put to the class at the time of the first meeting. They all showed a decided uncertainty as to the scope of the term "animal," a tendency not uncommon in older people. For I remember a person once insisting, referring to lobsters, star-fish, clams, and the like, that "they were not animals, they were *fishes*. Some of the answers received are almost equal in originality to, and are perhaps fully as scientific as the famous old definition of man, "a two legged animal without feathers."

For example take these. How far from gratifying the logical conclusion! "An animal is a beast." "An animal is a human being." In the next we have suggested the theory of degeneration. It states that "an animal is an inferior species of man."

The following need no comment:

"An animal is a living creature having hands or feet or both."

"An animal is a creature having four limbs and *a complete anatomy*."

"An animal is a combination of flesh and bones *and is supposed to be an inhabitant of the earth*."

"An animal is something with four feet and *possesses a brain of no consequence*."

"An animal is a living creature that is not stationary. Something that has to hunt for its food."

Here is one that is especially curious. Is not the doctrine of theosophy involved? "An animal, in my idea, is considered only a different specimen of humanity, different from persons in that it is dumb and differently shaped."

Here are two others: "An animal is a thing with life, that is larger than an insect and is not human." "An animal is an object having life, movement and intelligence. Nearly all have seven senses, tasting, feeling, smelling, seeing, hearing, common sense and nonsense." Finally this one: "An animal is a being created with life belonging to the animal kingdom." Who would say that this was wrong?

F. COLBY-LUCAS

BOOK REVIEWS

The Student's Chaucer. By THE REV. WALTER W. SKEAT. The Macmillan Company. $1.75.

CHAUCER is winning a place for himself in our secondary schools. Like our own Longfellow, Chaucer was the story-teller of the young civilization in which he grew up. To the literary treasures he brought from many lands he knew how to give a setting that might stand against both fashion and fate. Even young people take to Chaucer better than to any other of the greater names, except Scott. To be sure, a little language study is required to understand Chaucer. But how little! We can understand Chaucer as the Germans cannot understand Walther von der Vogelweide, Wolfram von Eschenbach, or Gottfried von Strassburg; as Italians, I dare say, cannot understand their great trecentists. Chaucer is not only nearer to us in time, but is brought still nearer by our reading in Shakespeare.

Fortunately we have now, after long waiting, a good text of Chaucer. Hitherto the *Canterbury Tales*, which every student should know as a whole, have been accessible *in toto* only in the reprints of Wright's one-sided text or in the selections edited, like a few of the other works, for philological students. Skeat's *Student's Chaucer*, however, gives us in one volume, with sufficient apparatus, a sound text of all the poet's works.

The *Student's Chaucer* stands in direct relation to the sumptuous Oxford edition by the law of *noblesse oblige*. The text is practically a reprint, space being saved by bracketing interpolations and marking emendations with an obelus. The apparatus is compressed into twenty-two pages of introduction, besides the text-critical appendix, which takes up the last fourteen pages of the body of the book, and the glossarial index, which takes up a hundred and fifty beautifully printed pages, separately numbered. The richness of the introduction is marvelous. Five pages give the known facts in Chaucer's life, together with brief abstracts of the documents. The writings and editions are treated in a little over two pages, enough at least for refer-

ence. Three more pages furnish a *vademecum* of Chaucerian grammar, which is practical and without philological cant. Meter and versification get each half a page; pronunciation not quite two pages — more than is usual in generalizations of the subject, and enough to satisfy the student that there is reason behind the dogma.

The text (718 pages) embraces the fragments (marked A, B, and C) of the Romaunt of the Rose, twenty-four minor poems, Boethius, Troilus, House of Fame, Good Women, Astrolabe, and Canterbury Tales. A justly liberal canon.

The glossarial index treat B and C of the Romaunt under a separate alphabet, leaving the main glossary truly a "well of English undefiled." The beginner gets help in graphical as well as lexical difficulties.

The volume is uniform with the one-volume editions of Wordsworth, Coleridge, Shelley, Keats, and Tennyson, and the reissue of the Globe editions, though of somewhat inferior typography. But the book, put out by the publishers immediately after their six-volume library edition, comes so nearly being a gift that one dislikes to find fault with the mechanical workmanship of the volume.

GUIDO H. STEMPEL

INDIANA UNIVERSITY

Elementary Geology. By RALPH S. TARR, B.S., F.G.S.A., Professor of Dynamic Geology and Physical Geography at Cornell University. The Macmillan Company.

THIS is the best text-book in elementary geology which has fallen under the notice of the writer. The author has not sought to write down to youthful students, but presents the subject at once with dignity and simplicity. To this end he has made a discriminating selection from the great body of facts offered by the science, and has unfolded the special themes with interest and a due sense of proportion. Of about 500 pages 105 pages are given to structural geology, 279 pages to the dynamic side of the subject, and 103 to stratigraphic, or, better we should say, historical geology, considering that the book is for beginners. The author's judgment is right in reserving fuller discussions of geological history for the college student.

There are 268 figures in the text, twenty-five plates, and a good index. The teaching power of the book is greatly enhanced by the

fullness and aptness of illustration, many phenomena being well shown which only the geology of the later years has recognized as important. The facts of physiography are not specially treated, because, as explained, already covered by the author's text-book in physical geography. Among the useful features is a tabular summary, closing the several chapters, gathering in a general view the agents and resulting phenomena. Among the best of these is the summary closing the chapter on weathering, on page 128. The chapters on weathering, wind erosins, and underground waters are especially good, and sum up facts familiar to the professional geologist, but not often adequately treated in elementary works. The twenty pages given to weathering are especially admirable. The illustrations include many not heretofore seen in text-books, and show that the author has drawn much from his own studies, and especially from the abundance of field illustration in the vicinity of Cornell University. Here, for example, fall plates I and VI, which, taken together, are most effective, one showing Ithaca Falls in flood time and the other the same in the dry season. One or two slips were noted, as "tilted" for inclined, referring to layers of wind-drift material, page 135, and on page 121, a too exclusive ascription, as it would seem to the present writer, of certain soils to glacial action. The volume as a whole deserves, and doubtless will have, large use in the secondary schools.

ALBERT PERRY BRIGHAM

COLGATE UNIVERSITY

Elementary Algebra. By H. S. HALL, M.A., and S. R. KNIGHT, B.A. Revised and enlarged for the Use of American Schools, by F. L. SEVENOAK, A.M., Assistant Principal of the Academic Department, Steven's Institute of Technology. New York: The Macmillan Co., 1896. Pp. 516 $1.10.

THIS algebra is a thoroughly usable text-book for schools that prepare for the various colleges and technical schools. In adapting a good English text-book, the American reviser has used uncommon judgment in leaving out non-essentials and in inserting only those parts of advanced algebra that are really profitable in college preparation. All the subjects required for admission to any American college or scientific school are treated clearly but concisely. The fundamental definitions and laws are given in simple but exact language. Points

usually obscure and puzzling to students are explained and emphasized in notes, inserted where they are most needed. The explanation of multiplication by a negative number is especially clear and convincing. Symbols and laws are first explained from an arithmetical point of view, and then by assuming these laws universally true, the author shows what meaning must be attached to symbols and operations which under unrestricted conditions cannot always be given arithmetical interpretation. Well chosen exercises in the use of symbolical expressions lead the student to the ready mastery of the statement of problems, a subject usually causing much trouble. The author's interpretation of negative results is especially strong. The factor theorem is introduced early so as to become a powerful aid in factoring and in demonstrating general theorems, *e. g.*, in proving the divisibility of $x^n \pm y^n$ by $x \pm y$.

Quadratics are properly placed after surds. The author may lose in symmetry because he does not confine himself to factoring methods in solving affected quadratics, but his method of completing the square proves easier to most students. The formula method is explained and regularly used in the more advanced problems of quadratics.

The author gives a good explanation of indeterminate and impossible problems, but makes an error when he states that "if the conditions give us a *greater* number of independent equations than there are unknown quantities involved, the problem is *impossible*." He should have said with Chrystal that "there is *in general* no solution." Permutations and combinations are admirably treated, so that students easily learn the demonstrations and master the problems. The proof of the binonical theorem for all positive integral values of n, gives the student a clear notion of mathematical induction. Enler's proof for any index is given for those who have time for the complete demonstration. The book closes with excellent chapters in determinants and the theory of equations, the latter including graphical representations of functions, a subject omitted from some text-books required for some colleges.

In a word, this algebra is simple but still complete. While it furnishes full preparation for college, it is easily taught and easily learned. Thc reviser is a practical teacher and not a mathematical egotist. Typographically the book is unexceptional. The pages and the cover are pleasing to the eye, and important words are carefully leaded or italicized. The book is not only scholarly and complete but it is cheap.

W. H. BUTTS

NOTES

THE report of the Committee on secondary Schools made to the National Council of Education at Milwaukee contains many interesting conclusions, but is open to criticism on a number of grounds. The first ground of criticism is the fact that the statistics are based upon the high schools of forty-six cities only. It need hardly be pointed out that no conclusions can be regarded as conclusive which do not rest upon a broader foundation than this. In the course of the report the statement is made, that the North and the East, with few exceptions, tend to co-education, but the South and the West to the opposite. We fancy this will be news to a great many high-school teachers North and East, South and West. The following is the summary of the conclusions:

1. The function of the high school is twofold (a) preparation for life, (b) for entrance into college.
2. The practice of the high schools show that both are feasible.
3. High schools are increasing in popular favor.
4. Secondary instruction is an essential part of public education.
5. High school attendance is not as large as is should be.
6. Opposition to high schools is growing less and less year by year.
7. The tendency is to reduce the number of courses of study in the high schools.
8. High schools generally are furnished with good libraries.
9. Physical culture is favorably considered as an essential part of the instruction in high schools.
10. Co-education is practiced in the majority of high schools, but there is growing sentiment in favor of separation.
11. The methods of promotion and graduation are various.

It can hardly be said that many of these conclusion are new, though most of them are good. A thorough study of the condition of the high schools of the country, based upon returns from a thousand schools, rather than half a hundred, is still greatly to be desired, and it ought to be undertaken on different lines from those followed in the report to the National Council.

THE fourth annual report of the Inspector of State High Schools for the state of Minnesota, covering the school year ending July 31, 1897, has just been issued. The report contains the following interesting facts: Four years ago, 77 schools were on the state list, whereas this year there have been 99. Eighty-seven of the 99 high schools have improved their high-school quarters during the period of four years either by building new buildings, enlarging or refitting. Nearly all the schools are enlarging their special and general libraries. An interesting experiment has been tried in the manufacture of physics apparatus for high schools by the State Prison, at a low price, repre-

senting cost of material and a nominal charge for labor. The total value of orders reported is $1901, and the total number of pieces supplied, 3254. The enterprise has proved successful and satisfactory on the whole. Instructors throughout the state have made suggestions freely, a new list has been made out, and the prison inmates are again at work on apparatus for delivery and use during the ensuing year. The total enrollment of high-school students was 11,218. There are 72 graded schools doing high-school work. The report discusses in helpful and scientific way methods of instruction in all high-school subjects, making the pamphlet a valuable pedagogical manual for the high-school teachers of the state. The following principles to govern a course in reading are worth reading themselves:

1. English classics should be made part of the daily programme for twelve years.

2. The arrangement of the course should facilitate consecutive training to get and appreciate thought.

3. Both poetry and prose, the central thought of which is easily apprehended, should be introduced early, even though it may be suitable for mature study. In the study of literature the central thought should be apprehended first. The subordinate and auxiliary thought should be apprehended first. The subordinate and auxiliary thought should be apprehended afterward in such detail as may be wise. Young pupils can get and appreciate the doctrine of "The Birds of Killingworth." They ought to have the poem simple and unadulterated.

4. Regard should be had to the stage through which the reader's mind is passing. "Hans in Luck" and "Emerson's American Scholar" are equally appropriate each at the right time. The culture epoch theory has sound philosophy in it.

5. Literary wholes should be read that their parts may be effective.

6. Whatever kind of reading young people like should be represented and be represented by the best of the kind.

7. Time should be given only to literature of permanent merit.

8. A course should be sufficiently flexible to consult the inclinations of instructor and students.

9. Moralizing should be diligently eschewed in favor of weighing character and motives.

10. Ethical content found in "Jack the Giant Killer" as well as in "Sesame and Lilies" should not exclude but should predominate all other considerations.

11. A course in English classics should give delight and develop intellectually, but its supreme end is to create standards of conduct and to move young people to their attainment.

12. If by empirical edict but one subject might be taught in public schools, that subject in an advanced civilization ought to be its native literature.

THE *Journal of School Geography* for September has a helpful article by Professor W. M. Davis on Topographic Maps of the United States, and the conclusion of Mr. R. H. Cornish's contribution on Laboratory Work in Elementary Physiography. The latter article is of special practical help to teachers, as it describes what the author actually did with a class last year.

Inspector Aiton has commended himself to the educational public generally as the right man in the right place. This report certainly will add to that conviction.

MR. ANDREW G. PEARSON has published, through D. C. Heath & Co., a book on Freshmen Composition, in which he sets forth the method of teaching English that has been so successfully pursued in the Massachusetts Institute of Technology.

THE Bibliography for use in Framing Classical Programmes for Secondary Schools by Professor I. B. Burgess, which was announced for this number of the SCHOOL REVIEW has been reserved to form a part of a special classical number for November.

TEACHERS of geometry will find profit and diversion in the "Famous Problems of Elementary Geometry,"—an authorized translation of a course of lectures by Professor Klein, the translators being Professor Beman of the University of Michigan and Professor Smith of the Michigan State Normal School. The work is published by Ginn & Co.

The same firm has in preparation "Historic Houses and Spots in Cambridge, Mass., and nearby towns," by J. H. Freese.

"Shakespeare Note Book," by Professor Chas. W. Kent, has a special feature,—ruled pages for notes on each play. These pages provide for notes on the title, subject, theme, plot, history, construction of the play, and for notes on other questions. (Ginn & Co.)

NEW PUBLICATIONS

SCIENCE AND PHILOSOPHY

Elements of Chemistry. By Rufus P. Williams, in charge of the Chemical Department of the English High School, Boston, and author of "Introduction to Chemical Science," "Chemical Experiments, General and Analytical," and "Laboratory Manual of Inorganic Chemistry." 5 x 7½ in.; p. 412. Ginn & Company.

A Text-Book of Physics, Largely Experimental, including the Harvard College "Descriptive List of Elementary Exercises in Physics." By Edwin H. Hall, Ph.D., Professor of Physics in Harvard College, and Joseph Y. Bergen, A.M., Instructor in the Harvard Summer School of Physics, and Junior Master in the English High School, Boston. Revised and enlarged. Size, 5¼ x 7½ in.; pp. 596. Henry Holt & Co.

Laboratory Work for Beginners in Botany. By William A. Setchell, Ph.D., Professor of Botany in University of California. 5 x 7 in.; pp. xiv+199. The Macmillan Co.

An Introduction to Geology. By William B. Scott, Blair Professor of Geology and Palæontology in Princeton University. 5½ x 8 in.; pp. xxvii+573. Price $1.90. The Macmillan Co.

First Book of Physical Geography. By Ralph S. Tarr, B.S., F.G.S.A., Professor of Dynamic Geology and Physical Geography at Cornell University. 5½ x 7¼ in.; pp. xix+368. Price $1.10. The Macmillan Co.

Physics for Grammar Schools. By Charles L. Harrington, M.A., Head Master of Dr. J. Sachs's School for Boys, New York City. Cloth, 12mo, pp. 123. Price 50 cents. American Book Company, New York, Cincinnati and Chicago.

Natural Elementary Geography. By Jacques W. Redway, F.R.G.S. Linen, 4to, pp. 144. With numerous Maps and Illustrations. Price 60 cents. American Book Company, New York, Cincinnati and Chicago.

Introduction to Philosophy. A Handbook for Students of Psychology, Logic, Ethics, Æsthetics and General Philosophy. By Oswald Külpe, Professor of Philosophy and Æsthetics in the University of Würzburg. Translated from the German (1895) by W. B. Pillsbury, Instructor in Psychology in the Cornell University, and E. B. Titchener, Sage Professor of Psychology in the Cornell University. 5 x 7¾ in.; pp. 256. Price $1.60. The Macmillan Co.

Vittorino Da Feltre and other Humanist Educators. Essays and Versions. An Introduction to the History of Classical Education. By William Harrison Woodward, Christ Church, Oxford; Lecturer in Education in Victoria University. 5½ x 7¾ in.; pp. xii+256. Price $1.75. The Macmillan Co.

MATHEMATICS

The Public School Arithmetic, based on McLellan and Dewey's "Psychology of Number." By J. A. McLellan, A.M., LL.D., President of the Ontario Normal College, and A. F. Ames, A.B., Honor Graduate in Mathematics; formerly Mathematical Master St. Thomas Collegiate Institute, etc.; Superintendent of Schools, Riverside, Ill. 5 x 7½ in.; pp. 346. Price 60 cents. The Macmillan Co.

Higher Arithmetic. By Wooster Woodruff Beman, Professor of Mathematics in the University of Wisconsin, and David Eugene Smith, Professor of Mathematics in the Michigan State Normal College. 5 x 7½ in.; pp. 192. Ginn & Co.

PEDAGOGY

Thirty Years of Teaching. By L. C. Miall, F.R.S., Professor of Biology in Yorkshire College. Reprinted, with Additions, from The Journal of Education. 5 x 7½ in.; pp. 250. Price $1.00. The Macmillan Co.

Organic Education. A Handbook for Teachers of Primary and Grammar Grades. By Harriet M. Scott, Principal of the Detroit Normal Training School, Detroit, Michigan. An account of the novel and highly successful methods employed by the author in the Detroit Training School for Teachers, together with full outlines of the work and lists of books and of illustrative materials. A highly suggestive and stimulating book. Price $1.25, postpaid. J. V. Sheehan, Publisher, Ann Arbor, Michigan.

ENGLISH LANGUAGE AND LITERATURE

Pitt Press Series. Bacon's Essays. Edited with Introduction and Notes by Alfred S. West, M.A., Trinity College Cambridge; Fellow of University College, London. 5 x 6⅞ in.; pp. 302. The Macmillan Co.

A First Book in Writing English. By Edwin Herbert Lewis, Ph.D., Associate Professor of English in Lewis Institute, and in the University of Chicago. 5 x 7 in.; pp. xiii+291. Price 80 cents. The Macmillan Co.

Riverside Literature Series. No. 116 (Double Number). Shakespeare's Hamlet. Board cover. 4¼ x 7 in.; pp. 191. Price 40 cents. Houghton, Mifflin & Co.

GREEK AND LATIN LANGUAGES AND LITERATURE

The Æneid of Virgil. Students' Edition. Translated into blank verse by Christopher Pearse Cranch. 5 x 8 in.; pp. 388. Price $1.00. Houghton, Mifflin & Co.

MODERN FOREIGN LANGUAGES AND LITERATURE

Third Year in French. By L. C. Syms, Bachellier Ès Lettres, Licencié En Droit de L'Universitie De France. 5 x 7½ in.; pp. 314. American Book Co.

HISTORY

American History Told by Contemporaries. Vol. I, Era of Colonization. Edited by Albert Bushnell Hart, Professor of History in Harvard University. 5½ x 8 in.; pp. xviii+606. Price $2.00. The Macmillan Company.

MISCELLANEOUS

Elocution and the Dramatic Art. By David J. Smithson, formerly Lecturer on Elocution at the University of St. Andrews, and also at the Royal Polytechnic Institution, London. New Edition. Revised by Chas. Reeve Taylor, M.A., LL.B., Lecturer in Public Reading and Speaking in King's College, London. 5 x 7½ in.; pp. 586. Price 90 cents. The Macmillan Co.

Some Observations of a Foster Parent. By John Charles Tarver. 5 x 7¾ in.; pp. xx+282. Price $1.75. The Macmillan Co.

Gantvoort's Music Reader. A Complete Music Course for Rural Village Schools, Singing Classes and Teachers' Institutes. By A. J. Gantvoort. 6¼ x 8½ in.; pp. 216. The John Church Co.

Elementary Drawing, A Series of Practice Papers for Beginners, Written and Illustrated by Elizabeth Moore Hallowell. 10 x 8 in.; pp. 54. Price 75 cents. The Macmillan Co.

The Young American. A Civic Reader. By Harry Pratt Judson, LL.D., Head Professor of Political Science in the University of Chicago. This supplementary reader, in a style that will appeal to young people, describes the origin and workings of our government, gives interesting accounts of stirring and momentous events in our national history, and contains literary selections of a patriotic character. The numerous illustrations include five full-page colored plates and two maps. Pp. 244. 12mo, cloth. Price 60 cents.

Experimental and Practical Physiology.

By B. P. COLTON, author of "Practical Zoology," and Professor in the Illinois State Normal University. A practical guide to the laboratory study of physiology, for high schools, normal schools, and colleges. Cloth; fully illustrated.

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Cloth, 397 pages. Introduction price, $1.12.

This standard and popular text-book has recently been thoroughly revised. The "Briefer Course" contains 248 pages, and is suited to schools that devote less than a year to the subject.

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